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The Solar Ocean Energy Liaison

Solar
OCEAN ENERGY
Liaison

INCORPORATING
The OTEC Liaison

VOLUME 7, NUMBER 1
January 1983

OTEC-1 COLD-WATER PIPE RECOVERED

In one of the deepest salvage operations on record, the 2300-foot-long OTEC-1 cold-water pipe (CWP) was recovered from the ocean floor at a depth of 4550 feet. The pipe was located, raised, and towed into port in mid-October from the site 20 miles off Kawaihae, Hawaii, where it had been resting on the bottom for over a year.

The salvage operation was conducted by the US Naval Forces, Hawaii, assisted by the Superintendent of Salvage and the Deep Submergence Offices of the Navy. The project was carried out under the direction of Joe Vadus of NOAA's OTEC Program Management Office, with Lieutenant Commander Dan Tracy, NOAA Corps, as project manager. Captain W. F. Searle Jr., former USN Superintendent of Salvage and world-renowned salvor, acted as consultant.

The manned deep-submergence vehicle *DSV Turtle* played an instrumental role in surveying the pipe in addition to cutting the deep-ocean moorings. The pipe was in a vertical floating position, but the anchor chain was lying on the bottom, since the syntactic foam had apparently lost some reserve buoyancy. The pipe was raised by a custom-equipped lift barge. A grappling hook was used to snag the 16-inch Sampson line connecting the pipe to the buoy and pull the pipe to the surface.

Witnesses reported that when the pipe was raised it erupted nearly 10 feet above the surface of the water. In a tricky and sometimes-tense operation, the lines attached to the CWP were transferred from the lift barge to the *USS Conserver* for the tow to port.

The towing operation took about 10 hours to cover the 20 miles to shore. When the tow began, the pipe was in a vertical position; but as the *Conserver* accelerated to its maximum speed of three knots, the entire pipe came within a hundred feet of the surface. As the ship approached shore, it had to turn, whereupon the pipe dropped back down to the bottom in 90 feet of water.

From that point a surface-effect salvage operation was conducted to float the CWP into the harbor, where it now rests alongside the breakwater. After some modification, the pipe—which now belongs to the

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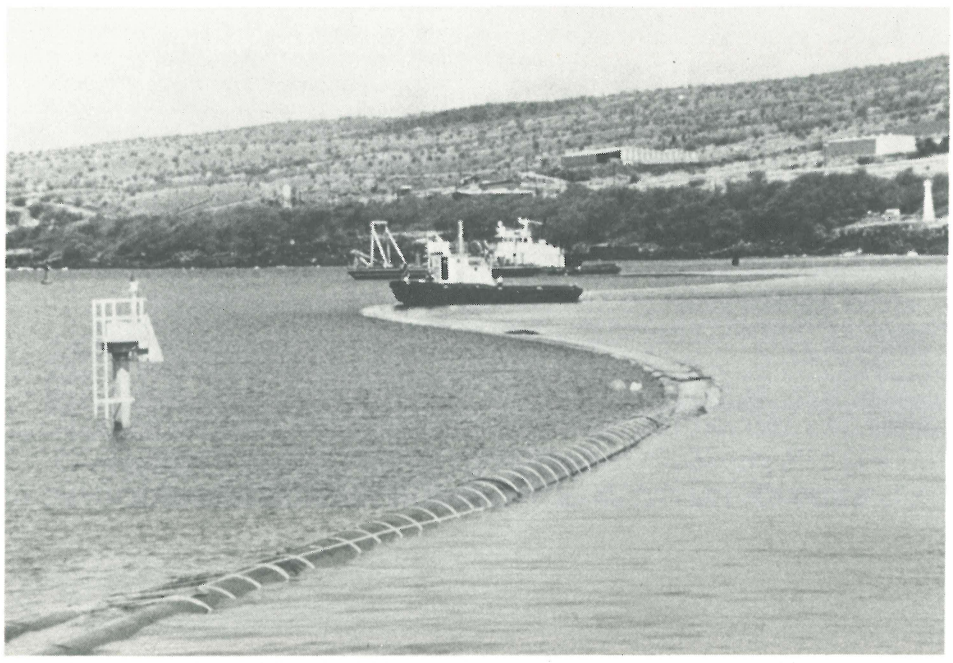

The OTEC-1 cold-water pipe is shown here as it is towed into the harbor at Kawaihae Point after its successful recovery from a depth of 4550 feet.

NEW DOE HEAD HODEL IS "FAVORABLY INCLINED" TOWARD BUILDING OTEC-40

Newly appointed Secretary of Energy Donald Hodel (see the November issue of OE) underwent confirmation hearings before the Senate Energy Committee in early December. During the questioning, Senator Spark Matsunaga (D-Hawaii) was the voice of the OTEC community.

Senator Matsunaga was most concerned with ocean thermal energy conversion work at DOE. Calling Hodel an "enigma" for talking about the importance of a Federal role in energy and then calling for a "merger" of the Departments of Energy and Commerce, Matsunaga asked: "If OTEC is zeroed out, you will not endeavor to have the President change his mind... [or will you]?" Said Hodel: "I will not hesitate to try to change the minds of the people I work with [including the Office of Management and Budget]. But, if I'm not successful, I will not desert my obligation to the President."

After Hodel said he has no specific position on OTEC, Matsunaga argued that "unless we build it [the 40-megawatt pilot plant], others will be selling it to us." Hodel commented that this "is a problem that is pervasive across the spectrum.... We have gained the technological lead and we have to maintain it." But, he said, "I can't commit myself to the follow-on [contracting on OTEC-40]. I think it's fair to say I am favorably inclined."

[The above information is reprinted, with the permission of the editor, from the *Solar Energy Intelligence Report*, Volume 8, Number 48, Page 395.]

Several days after his confirmation, Hodel attended a reception sponsored by advocates of renewable energy, at which a number of members of the OTEC community were present. One Washington DC attorney who, while intimately familiar with OTEC, was unaware of the dialogue that had taken place between Hodel and Matsunaga earlier, asked Hodel if he knew much about DOE's OTEC program. Hodel replied: "OTEC was brought to my attention—somewhat forcefully, I might add—just the other day by Senator Matsunaga."

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AN INTERNATIONAL NEWSLETTER ENGAGED AS LIAISON FOR ALL FORMS OF SOLAR ENERGY FROM THE SEA, INCLUDING:
OTEC
(OCEAN THERMAL ENERGY CONVERSION)
WAVE - TIDAL - CURRENT
OFFSHORE WIND - BIOMASS
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SOLAR OCEAN ENERGY

DOE SOLAR R&D PANEL GIVES OTEC LOWEST PRIORITY, RECOMMENDS MINIMAL FUNDING

At the request of Don Fuqua, chairman of the House Committee on Science and Technology, the Energy Research Advisory Board (ERAB) of DOE has prepared an assessment of Federal solar-energy policy with recommendations for future R&D priorities. The report, released in September by the *ad hoc* Solar R&D Panel, is titled "Solar Energy Research and Development: Federal and Private Roles". The study covers seven past solar-energy programs, including OTEC, regarding which the Panel concluded that "DOE should complete its involvement in the preliminary OTEC design program but should not participate in any further commercial OTEC demonstrations. A modest technology base activity should be continued by DOE, however, to support private efforts."

The 14-member Solar Panel was composed of individuals from industry, academia, and one state government, and included representation from one company involved in OTEC, namely General Electric. ERAB, which has 22 members and a similar mixture of representation, includes two vice-presidents of companies historically active in OTEC R&D, namely GE and TRW. During a series of five meetings held between May and August 1982, the Panel members listened to talks by Bill Richards of DOE's Ocean Systems Branch, Fred Naef of Lockheed, Bill Avery of the Johns Hopkins University Applied Physics Lab, and Art Butler of TRW. On the basis of these reports, in combination with several staff studies on support of solar R&D, the Panel established a list of priorities for Federal solar research in which OTEC is listed among the lowest.

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DEEPWATER SUBMERSIBLE VEHICLES DIVE AT TWO OTEC PLANT SITES

With increasing attention being given to shelf-mounted and land-based OTEC plants (both DOE-funded pilot plants are so configured), the question of offshore-slope gradient has become more significant in the last few years. The engineering difficulties associated with cold-water-pipe deployment on extremely steep gradients have precipitated a literally in-depth re-examination of the shelf slopes at two potential OTEC sites in recent months—off Hawaii and Puerto Rico.

The first-hand observations were conducted by Dan Fornari, President of Offshore Investigations Limited, aboard the deep-submergence vehicles *DSV Turtle*, off Hawaii in October, and *DSV Alvin*, off Puerto Rico in November. Fornari was in Hawaii to consult on the OTEC-1 cold-water-pipe recovery (see story elsewhere in this issue) and some other work, when he was asked by Rockwell International's Energy Technology Engineering Center to make the dive at the pilot-plant site off Kahe Point, Oahu. The dive substantiated his own and others' opinion that the slope gradient was steeper than had previously been thought. This finding prompted the Puerto Rico Electric Power Authority to contract Fornari to dive at Punta Tuna, Puerto Rico's prime-candidate OTEC site.

Since the *DSV Alvin* was in Saint Croix, Virgin Islands (not far from Puerto Rico) during November, Fornari was able to make these dives reasonably soon after completing the Hawaii work. Two Puerto Rico sites were investigated—off Punta Tuna and off the coast of Ponce.

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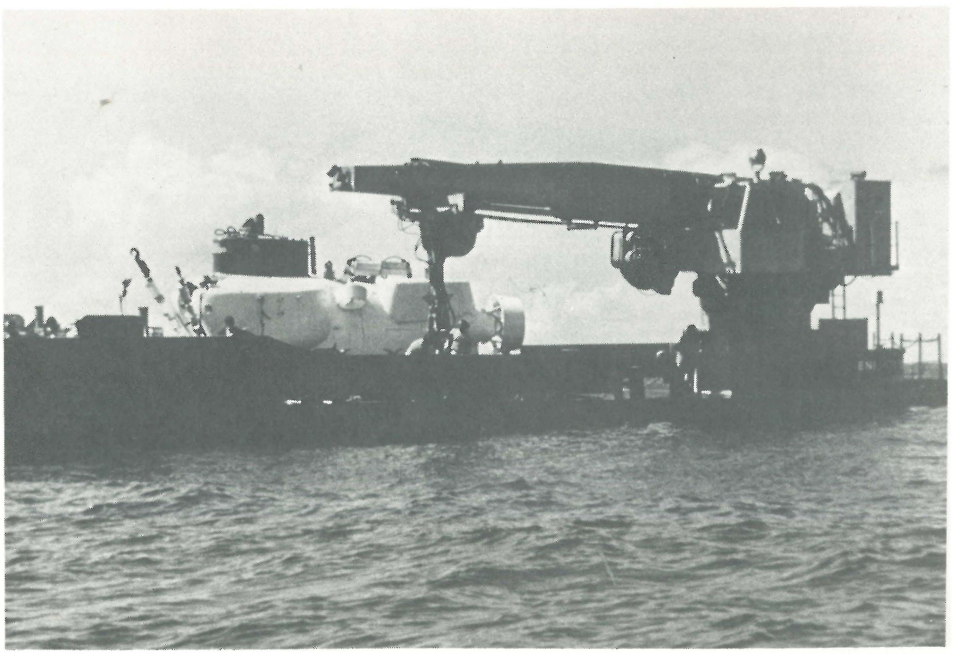

The DSV Turtle aboard the specially equipped lift-barge during the OTEC-1 CWP recovery. The Turtle later dove off Kahe Point to inspect the slope of the shelf where the cold-water pipe(s) will be deployed for the 40-megawatt pilot plant(s).

UN ANTICIPATES EARLY OTEC COMMERCIALIZATION; PREPARES GUIDE FOR DEVELOPING NATIONS

In sincere anticipation of the impending commercialization of OTEC, a branch of the United Nations is preparing a *Guide to OTEC for Developing Countries.* The Ocean Economics and Technology Branch of the UN's Economic and Social Council is publishing the Guide to provide information on the most recent advances in OTEC technology, particularly small plants, and on the steps necessary for developing nations to assess OTEC viability.

The Guide was also prepared to correct several misconceptions regarding the availability, cost, and efficacy of OTEC. As noted in the introduction, OTEC technology for land-based or shelf-mounted plants up to 50 megawatts is essentially available today, and could be built by qualified engineering companies prepared to warrant its successful operation.

Costs for OTEC plants smaller than 50 megawatts are calculated to be competitive today with oil-fired plants in many locations, particularly remote islands. OTEC plants do not involve high-technology systems as do nuclear plants, the Guide points out, but are relatively simple to build and operate, giving developing countries an opportunity to participate in construction as well as in operation and maintenance.

The Guide focuses on the near-term application of OTEC to developing countries, stating that "the technology has been developed and demonstrated to a sufficient degree so that many *nations should consider this a potential source of useable energy in the next three to five years.*" The Guide contains a step-by-step methodology for assessing OTEC applicability, including site identification, environmental considerations, costs, and secondary applications and industries. The document is addressed to a broad range of concerned parties (energy planners, government and utility-company officials, and other decision makers) on an essentially non-technical level.

The first chapter, about a third of the 100-page document, explains the OTEC concept and systems. This section consists chiefly of a discussion of OTEC products such as electricity, fresh water, and ammonia, and of the potential contribution of OTEC to a nation's energy needs. The Guide also notes several potential general contributions in the area of national infrastructure, such as enhancement of domestic labor skills, development of national technological capability, increased knowledge of offshore environment and resources, and expanded commercial potential.

The second chapter deals with OTEC planning and assessment. The first step, according to the Guide, is to consider a nation's energy market and indigenous resources. Once the need for additional energy sources has been established, an assessment of the applicability of OTEC should be undertaken, including consideration of physical setting and environmental concerns (such as the nature and extent of the thermal resource), the comparative costs of OTEC and other energy sources, the plant size and by-products, design configurations, centralized versus non-centralized use, overall economic conditions, institutional and infrastructural requirements, political and legal issues, social and cultural issues, and financial concerns. These elements are discussed in varying detail, but serve to make the reader aware of the broad implications of OTEC commercialization for one's own country or region.

Chapter 3 deals with OTEC costs and economics. The opening section points out that while capital costs may be high, there are no fuel costs, and OTEC costs will thus remain essentially fixed over the life of the plant, increasing OTEC competitiveness with even modestly increasing fuel costs. In discussing plant configurations and component costs, the Guide notes certain advantages of land-based and shelf-mounted plants over floating plants, at least in early commercial stages and at suitable sites. Plant and component design and costs are site- and user-specific, so several examples of OTEC cost studies of specific projects are cited for comparison. The impact of OTEC on local infrastructure and industry is discussed, along with possible avenues of participation by local labor in construction, operation, and maintenance.

The Guide concludes by maintaining that OTEC is "very close to commercialization" and is "particularly well suited

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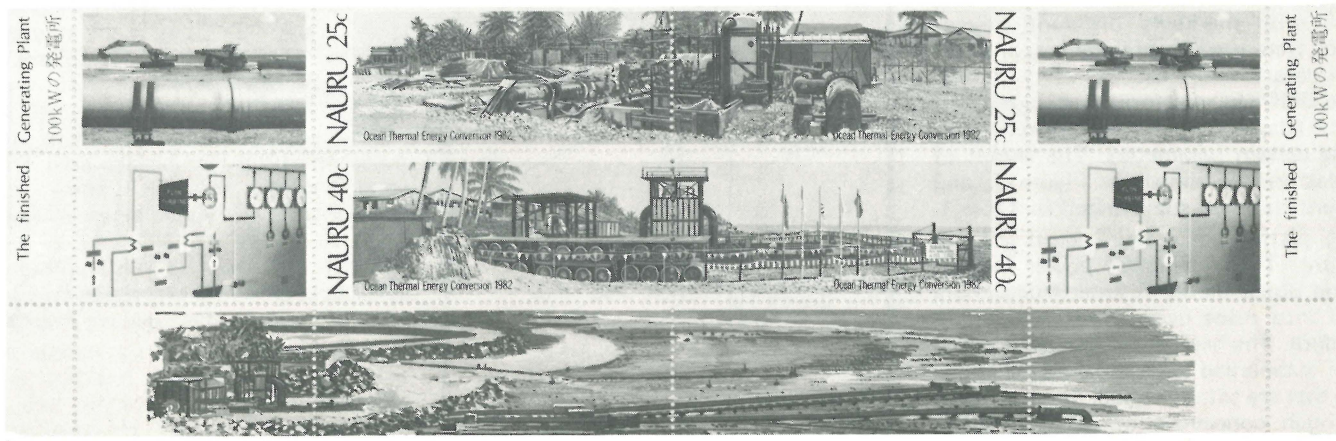
NAURU COMMEMORATES OTEC WITH NEW POSTAGE STAMPS

The Republic of Nauru has issued two OTEC commemorative postage stamps. The colorful stamps, first issued in June but only recently received in the United States, are in two denominations, 25¢ and 40¢ (Nauru), and in each denomination the stamps are in pairs. The 25-cent pair portray the construction of the Nauru test facility built and operated by the Japanese earlier this year (see the April and May 1982 issues of OE), and the 40-cent pair depict the facility on its inauguration day. The borders of the sheets of stamps (10 stamps to a sheet) are composed of colorful photographs and paintings of components and scenes around the OTEC facility.

Attempts to obtain full sheets have proven unsuccessful in the Chicago area, however some sample sets were purchased and are reproduced in this issue. There are apparently only a small number of these stamps in the US, so readers who wish to purchase them should contact their local stamp dealers for prices and availability.

OE would like to thank Bob Cohen for calling our attention to the Nauru stamps.



The OTEC commemorative stamps issued in June by the Republic of Nauru. (Top) Two 25-cent stamps depict construction of the facility, and the border shows the CWP. (Middle) The 40-cent denomination is a picture of the facility on opening day, and its border shows the control station. (Bottom) An artist's rendition shows the CWP at low tide.

[Note: The following is the fourth in a series of monthly articles covering recent OTEC-platform concept developments.]

GIANNOTTI & ASSOCIATES' SHELF-MOUNTED OTEC PLATFORM

In October the marine architecture and engineering firm of Giannotti & Associates published their final report on a SMOTEC (shelf-mounted OTEC) platform benchmark design. Their conclusion was that the platform and pipe systems are technically feasible, with pipe installation and platform-foundation preparation being the most problematic aspects of this concept. Remaining areas of development necessary to reduce the risk of SMOTEC systems are identified, but do not pose significant obstacles to near-term deployment.

The development of the benchmark SMOTEC design was based on a previous study which identified eight possible configurations for shelf-mounted platforms. The best elements of three of these options were combined to form the baseline platform on the basis of the following considerations:

- minimal development of new technologies;
- submerged structure depth maximized to minimize loads and moments on the structure;
- structure is relatively transparent at wave zone;
- construction can be performed at the maximum number of locations;
- power-plant components are installed and tested during construction;
- components are either above water or easily retrievable;
- structure is removable for shipyard maintenance and repair;
- system components can be expanded with minimum rework.

Power cycle and platform-to-shore cable were not addressed, although the power cycle under consideration in the design was a closed-cycle system. SMOTEC platforms deployed in relatively shallow water (300 feet) must be designed to suit environmental conditions such as slope, bottom characteristics, and waves at specific sites. Thus two sites off Hawaii (Kahe and Keahole Points) with markedly different characteristics were used to provide baseline reference data.

The SMOTEC platform was so designed as to be adaptable to several different sites, varying certain parameters. The layout of the platform is shown in Figure 1, and pertinent data are summarized in Table 1.

The platform is a four-legged jack-up structure. The submerged power module and the upper platform superstructure are jacked into place using a self-installation procedure. The heat exchangers are located in the submerged power module in open banks that are totally sealed. Seawater flow is through concentric inner cylinders in each leg into plenums in the power module. Concentric-cyclinder construction pro-

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PLATFORM FOR BOTH KAHE POINT AND KEAHOLE POINT

Structure Description:	Permanent Steel Jackup with Submerged Power Module
Deployment Technique:	Floatout on Sealed Power Module (PM) legs jacked down to PM level; PM flooded and buoyancy transferred to upper structure (US). Legs jacked to floor; US jacked up to proper elevation.
Structure Overall Height:	410 ft
Upper Platform Envelope:	220'W x 220'L x 60'H
Submerged Power Module Envelope:	220'W x 220'L x 40'H
Support Structure:	4 legs of concentric cylindrical shells with joining stiffeners 30' OD 2" wall outer pipe with jacking lugs 22.5' OD .5" wall inner pipe for seawater flow
Approximate Weight	
Legs:	4,000 tons
Upper Platform:	12,000 tons - 6000 tons OTEC equipment - 6000 tons deck and modules
Power Module:	4,000 tons
Environmental Loads: (100 year storm)	Horizontal Load 15E3 kips Overturning moment 1.6E6 kip-ft. Vertical load 9.8E3 kips

TABLE 1 - SMOTEC PLATFORM PARAMETERS

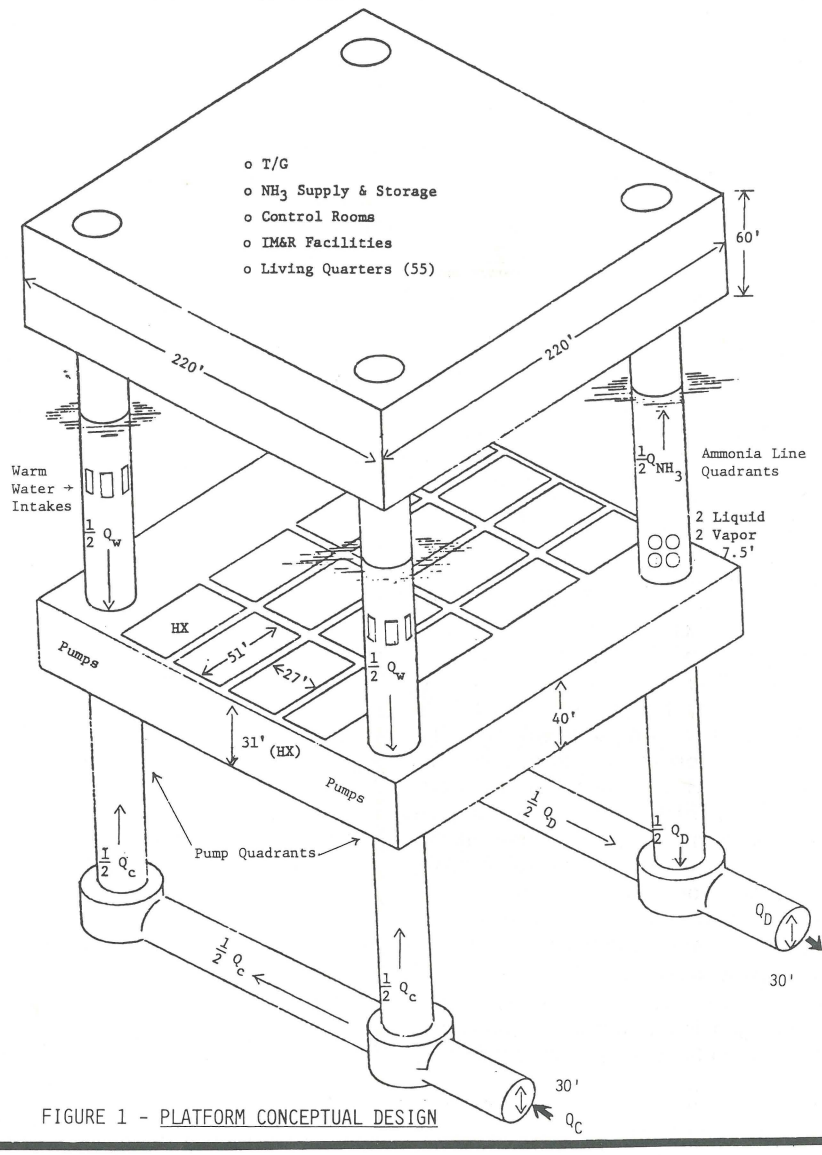

FIGURE 1 - PLATFORM CONCEPTUAL DESIGN

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vides the legs with additional strength. The plenums are sealed by sliding doors, allowing the module to be buoyant during tow-out and permitting isolation of the heat exchangers for inspection, maintenance, and repair. The upper platform houses all other equipment and personnel, and is similar in size and weight to present offshore platforms. The crew remains entirely above sea level, following standard practice.

The foundation of the entire platform will be a combination of systems. Gravity mats, pads, and piling will be considered, depending on the slope and composition of the sea floor. Jack-up platforms have been permanently installed in the North Sea for more than a decade with no history of major platform failure. Past jack-up failures in the offshore oil industry have resulted from factors not applicable to relatively permanent, site-specific SMOTEC platforms, such as frequent movement between sites with extremely variable sea-floor characteristics at different sites.

The baseline cold-water pipe (CWP) and pipe foundation are also defined, but the design is such that variations in construction and deployment are possible to suit site-specific characteristics. Essentially the pipe is a series of negatively buoyant segments connected by a clamp/seal system supported by piles. The piles allow a high-strength support while exhibiting a unique ability to adapt to different bottom conditions. Procedures for system installation should be a straightforward extension of existing offshore-industry techniques to deeper depths and steeper slopes. The CWP concept is shown in Figure 2.

(Any readers who would like to submit information for inclusion in this series of articles on OTEC platforms should call or write Philip Haring at OE. This is an open-ended series covering technical and economic aspects, and will continue as long as information continues to come in.)

One advantage of this pipe design is the suitability of a variety of construction materials (FRP, steel, and lightweight concrete). Additional strength is provided by a system of circumferential and longitudinal stiffeners, in a technique being used more and more in the offshore oil industry. Segmentation of the pipe will also facilitate transportation by barge from fabrication site to deployment site, and will simplify the pipe-to-platform connection. Steel and concrete pipe designs will follow standard practice, while FRP pipe (either single-thickness or composite) will require some form of development to determine optimum configuration. Construction with any of these materials can be performed using existing and proven technology.

The clamps serve two functions: they connect and seal the joints between pipe spans, and provide structural support for the pipe segments. They are designed to be passive (requiring no remote operation in the pipe deployment) and will enable the retrieval of pipe segments. Further clamp development will identify the most efficient, durable, and high-strength sealing system.

The design options for CWP piles consider a variety of sea-floor characteristics, and can easily be fabricated with present technology. Installation procedures will be site-specific and include either hammering or drilling. Techniques for accurate pile placement and for setting the pipe on the piles will require further development. Application of gravity foundations to shelf-mounted CWPs is not viewed as very promising due to the steep slopes encountered along the length of the pipe.

In general, the jack-up SMOTEC concept and the benchmark pipe design developed at Giannotti have certain advantages that adapt well to the OTEC program. These include flexibility of construction and deployment options to suit specific site requirements; minimal development of new technology and procedures; ease of inspection, maintenance, and repair; transparency to environmental loading; and retrievability or ease of relocation. SMOTEC plants also do not require costly and yet-unproven deep-ocean moorings and electric riser cables, as do floating plants.

Certain areas of further development or testing are also identified. These include model tests to determine environmental loading on the pipe and platform, confirmation testing of installation and construction procedures, and a more complete assessment of inspection, maintenance, and repair capabilities of manned and unmanned systems. These further-development needs do not appear to severely constrain possible near-term utilization of the SMOTEC design for commercial plants.

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State of Hawaii—will be towed to the Seacoast Test Facility, where it will be used for future OTEC projects.

Several lessons were learned from this recovery operation. First and foremost it was learned that such a recovery could be made, despite the pessimism of some individuals. This operation certainly reaffirmed the US Navy's professionalism and skills in deep-ocean salvage and ocean engineering.

A second lesson learned is that the cost of a CWP recovery project is much less than predicted. In Congressional hearings on the OTEC Act of 1980, commenting on a proposed provision that all components be removed from a site when an OTEC plant is taken off-station, one witness estimated that CWP recovery would cost $10 million or more. But in fact the entire OTEC-1 CWP recovery, which took less than two weeks, cost only a million dollars.

A third lesson learned from this operation is that it is desirable to use a jettisonable ballast weight at the base of the pipe. One of the problems encountered in this project was the disconnection of the weight from the pipe.

Congratulations are in order for all the individuals and agencies involved in this historic operation. The successful CWP recovery is a large step forward for the entire OTEC community.

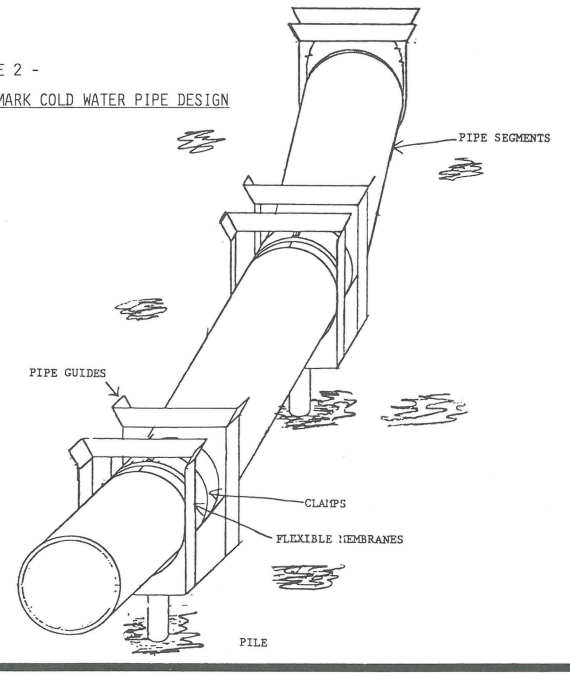
CORRECTIONS

(1) Wouldn't it be wonderful if we had 110 years of data on submerged concrete spheres? Unfortunately, the project was only started in 1971, not 1871, as reported on Page 1 of our September issue.

(2) The correct name of the President of EPCO Incorporated is John R. Noll, not Moll, as reported on Page 2 of our November issue.

Please accept our apologies for these errors.

FIGURE 2 -
BENCHMARK COLD WATER PIPE DESIGN



BUDGET UPDATE

As of press time, the Federal Budget for FY 1983 had not yet been finalized. Despite yet another year of "the ax", the OTEC program still lives, although there is considerable confusion as to the exact amount of Federal support being provided.

Looking at both the Senate and House appropriation bills, there appears to be a budget in the range of $10.5 to $15 million for OTEC. The Senate version includes $7 million for two awards to continue the Pilot Plant project, and $4 for selected R&D projects. No mention is made of the $4 million deferred from FY 1982, and therein lies the confusion: Is this included in the $11 million, or added on, making the budget $15 million? The figure coming from the House side is $10.5 million, which includes the $4 million deferred. There has apparently been an assurance that two Pilot Plant awards for Phase II will be made in any case. The target date for the final budget is March 6th, a Sunday.

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The re-assessment of solar R&D priorities was deemed necessary in the light of changing overall Federal policies. Regarding energy development, the new Federal policies emphasize long-term, high-risk, potentially high-payoff R&D for which market incentives are not sufficient to maintain continued research. For each of seven solar technologies, the appropriate Federal role was defined in order to maintain a sufficient scientific and technical base while leaving the eventual commercialization to private industry as each of these technologies becomes competitive in the marketplace.

Of these seven solar R&D options (basic research, photovoltaics, solar thermal energy, wind energy, OTEC, biomass, and solar buildings) OTEC was the only program not to receive any high- or medium-priority ratings for any of its subprograms. Preliminary design of the 40-megawatt pilot plant and a modest R&D effort were given the lowest funding priority, while demonstration and pilot-plant work beyond the design stage was not recommended for any Federal support. This decision was based not on the belief that OTEC commercialization is imminent, but on the belief that a decision point for private industry can be approached in the next few years if selected areas of Federally supported development are maintained at a relatively low level.

The executive summary of the 108-page report includes the statement that "for some technologies... the private sector is ready to begin or has already begun commercialization; for others, such as OTEC, decreases in Federal funding will result in a slowdown or termination." In contrast, the report notes that the Panel was "encouraged by DOE statements that the industry will complete Phases III and IV (detail design through operation) by using non-Federal funds and the significant economic incentives available through the tax credits."

Among other observations on the status of OTEC development, the Panel maintained that the commercial potential of OTEC in the US and elsewhere has yet to be determined, and that verification of cost estimates through experience is essential before the perceived risk of OTEC can be sufficiently reduced to enable private financing of OTEC plants. For this reason, design and construction of a pilot plant must be considered a necessary step in OTEC development, according to the report, yet Federal support is not recommended through this entire program.

The report also notes that due to engineering uncertainties regarding the cold-water pipe and electrical riser cable, the Federal program in floating OTEC plants has been discontinued. The Panel was disappointed to learn that the large expenditure of Federal funds for the one-megawatt floating OTEC-1 project netted only three months of at-sea test data, rather than the scheduled 36 months.

Commenting on the state of OTEC, the report accurately describes the emerging industry as involving chiefly several major companies whose traditional businesses include supplying the defense, aerospace, electric-utility, and oil-field markets, augmented by a variety of hardware-component suppliers and engineering and environmental consultants. No mention is made of entrepreneurial OTEC ventures, of which at least three are currently under way in the US alone. The report expresses doubt as to whether any company has yet accumulated enough information to commit either a major investment in a large-scale OTEC plant or the production facilities required to supply OTEC components.

"With a modest budget for Federal research and preliminary design, and the combination of current tax incentives," the report continues, "commercialization by private industry is possible," with early commercialization most likely to occur in certain chemical production and remote power applications, and with shelf-mounted or land-based plants.

The report concludes that:

(1) OTEC has potential as a long-term energy source and as an export technology. DOE should support Phase II assessments for the current OTEC 40-megawatt scale-up, but with limited funds, and should not proceed with construction at this time.

(2) The OTEC budget for Fiscal 1983 should not be entirely eliminated. A modest effort should continue in support of private investment in basic materials for OTEC components, such as the shore and shelf cold-water pipe, heat exchanger, and similar activities, as well as for resource and environmental assessments.

8TH OCEAN ENERGY CONFERENCE PROCEEDINGS NOW AVAILABLE

The Proceedings of the 8th Ocean Energy Conference, held in Washington DC in June 1981, are finally available—18 months after the end of the Conference. The two-volume set contains nearly 1100 pages of reports covering the entire spectrum of ocean-energy subjects from technical to economic to legal. Conference attendees should be receiving their complimentary copies in the mail shortly. Additional copies may be obtained from the National Technical Information Service, US Department of Commerce, Springfield, Virginia 22161, at a cost of $70.50 for paper, $8 for microfiche. Be sure to specify Document DOE/CONF 810622-EXC.

(continued from Page 2)

The official reports of both projects will not be publicly available until January. However unofficial comments from several sources indicate that the slope off Kahe Point, Hawaii is steeper, and thus more problematic for CWP deployment than anticipated. Observers of the Puerto Rico dives found nothing to indicate that Puerto Rico could not deploy a cost-effective shelf-mounted plant at either site, but there is some opinion that the dive at Ponce was prompted by findings at Punta Tuna (which indicated a steeper-than-anticipated slope). Once again, these are unofficial reports. OE will update this story as new information becomes available.

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to" and "holds great promise for" developing countries. The realistic point is made that, although developing countries should participate in planning for OTEC, they should not be expected to underwrite research and development costs. Instead they can contribute in-kind resources as their infrastructures may allow. In this way, the Guide notes, they may be able to increase their technological capabilities and assist in lowering OTEC energy costs.

The Guide will be periodically updated. Its release will coincide with the publication of several other relevant UN documents, including a report on renewable-energy planning for coastal-area development and a report on marine-pollution implications of ocean-energy exploitation.

The release of the *Guide to OTEC for Developing Countries* and the other publications is highly significant for the commercial OTEC industry, implying that 1983 will be one of the biggest years to date for OTEC, with the possibility that at least one commercial venture will be crystallized in the upcoming months.

INTERNATIONAL QUARTERLY CALENDAR: 1983

Jan 1-28: Expo Offshore Asia '83, an 18-day floating exposition, visiting six countries, presenting information on the latest offshore technology, products, and services, aboard *Worldwide Expo*, sailing from Bangkok. The official carrier for US exhibitors is Thai Airways International, departing from Dallas and Seattle. Sponsor: Gulf Publishing Company, Houston, Texas, phone (713) 529-4301 or (800) 527-5225.

Jan 10-12: Aquaculture 1983, Washington Hilton, Washington DC. Contact: Aquaculture/WDC/83, PO Box 55060, Little Rock, Arkansas 72205, phone (501) 661-7677.

Jan 16-21: Effective Management of Technological Innovation, Sea Island, Georgia. Sponsors: Technology Futures Incorporated and Industrial Management Center, both of Austin, Texas. Contact: Carolyn Vanston, TFI/IMC, 411 West 13th Street, Austin, Texas 78701, phone (512) 478-1793.

Jan 24-28: Seventh Annual Meeting on Energy From Biomass and Wastes, Lake Buena Vista, Florida. Contact: Institute of Gas Technology, 3524 South State Street, IIT Center, Chicago, Illinois 60616, phone (312) 567-3650.

Jan 28-31: Fourth Alternative Energy Conference, Anchorage, Alaska. Contact: Judy Zimiki, 1069 West Sixth Avenue, Anchorage, Alaska 99501, phone (907) 277-2134.

Jan 30-Feb 3: ASME Energy Sources Technology Conference and Exhibition, Houston, Texas. Sponsor: American Society of Mechanical Engineers, New York. Contact: Frank Demarest, ETCE, PO Box 59489, Dallas, Texas 75229, phone (214) 247-1747.

Jan 30-Feb 4: Technology Forecasting Workshop, Sea Island, Georgia. Sponsors: Technology Futures Incorporated and Industrial Management Center Incorporated, Austin, Texas. Contact: Carolyn Vanston, TFI/IMC, 411 West 13th Street, Austin, Texas 78701, phone (512) 478-1793.

Feb 9-11: Warm-Water Aquaculture-Crustacea, Brigham Young University, Hawaii Campus. Contact: T. Aaron Lim, BYU, Laie, Hawaii 96762, phone (808) 293-3444.

● **Feb 28-Mar 2: Tenth Annual Technology Conference and Exposition (ET '73)**, Washington DC. Sponsors: American Gas Association Incorporated, Arlington, Virginia; Electric Power Research Institute, Palo Alto, California; Gas Research Institute, Chicago, Illinois; and National Coal Association, Washington DC. Contact: Martin L. Heavner, GII, 966 Hungerford Drive (24), Rockville, Maryland (20850), phone (301) 251-9250.

Mar 17-19: Coastal Zone Resources and Law of the Sea Expo '83, World Trade Center, Singapore. Contact: Cahners Exposition Group, Cahners Plaza, 1350 East Touhy Avenue, PO Box 5060, Des Plaines, Illinois 60018, phone (312) 299-9311.

Mar 19-24: International Symposium and Workshop on Renewable Energy Sources, Lahore, Pakistan. National Science Foundation, Washington DC, and Ministry of Science and Technology, Islamabad, Pakistan. Contact: T. Nejat Veziroglu, Clean Energy Research Institute, University of Miami, PO Box 248294, Coral Gables, Florida 33124, phone (305) 284-4666.

● **Mar 20-24: Joint Thermal Conference**, Honolulu, Hawaii. Sponsors: American Society of Mechanical Engineers and Japan Society of Mechanical Engineers. Contact: Walter Mockert, Meetings Manager, ASME, 345 East 47th Street, New York, New York 10017, phone (212) 705-7050.

Apr 18-20: American Power Conference, Chicago, Illinois. Sponsor: Illinois Institute of Technology, Chicago. Contact: R. E. Armington, IIT, 127 Siegel Hall, Chicago, Illinois 60616, phone (312) 567-3406.

Apr 18-22: Corrosion '83, Anaheim, California. Sponsor: National Association of Corrosion Engineers, Houston, Texas. Contact: Meetings Manager, NACE Headquarters, PO Box 218340, Houston, Texas 77218, phone (713) 492-0535.

Apr 19-23: Energy '83—International Trade Fair and Congress, Hamburg, Germany. Contact: Hamburg Messe and Congress GmbH, Jungiusstrasse 13, Postfach 30 23 60, 2000 Hamburg 36, West Germany, or Hans Rathje, Inter-view Communications Incorporated, 545 Madison Avenue, New York, New York 10022, phone (212) 758-4651.

● **May 2-5: Offshore Technology Conference, 1983**, Houston, Texas. Sponsor: American Society of Civil Engineers. Contact: Carl E. Nelson, ASCE, 345 East 47th Street, New York, New York 10017, phone (212) 705-7672, or Program Manager, OTC, 6200 North Central Expressway, Drawer 64706, Dallas, Texas 75206.

May 9-13: 17th International Symposium on Remote Sensing of the Environment, Ann Arbor, Michigan. Sponsor: Environmental Research Institute of Michigan, Ann Arbor. Contact: Remote Sensing Center, ERIM, PO Box 8618, Ann Arbor, Michigan 48107, phone (313) 994-1200.

May 25-27: Tenth Annual Engineering Conference on Reliability, Availability, and Maintainability for the Electric Power Industry, Montreal, Quebec, Canada. Sponsor: Institute of Electrical and Electronics Engineers Incorporated, New York. Contact: Jean Dind, Hydro-Quebec, 75 West Dorchester (1010CD), Montreal, Quebec H2Z1A4. Canada.

Jun 1-4: Coastal Zone '83, San Diego, California. Sponsors: American Society of Civil Engineers, Federal Office of Coastal Zone Management, California Coastal Commission, Coastal States Organization, and US Naval Facilities Engineering Command. Contact: Coastal Zone '83, PO Box 26062, San Francisco, California 94126.

Jun 5-10: Technology Forecasting Workshop, Castine, Maine, and

Jun 12-17: Effective Management of Technological Innovation, Castine, Maine. See calendar entries for January 16th and January 30th.

Aug 15-19: Solar World Congress, Perth, Australia. Contact: Conference Secretariat, Solar World Congress, PO Box X2275, Perth, WA 6001, Australia.

● **Aug 29-Sep 1: Oceans '83**, San Francisco, California. Sponsors: Marine Technology Society and Institute of Electrical and Electronic Engineers' Council on Oceanic Engineering. Contact: Oceans '83, Tech Program Chairman, PO Box 71030, Sunnyvale, California 94086.

Sep 6-9: First International Energy Exhibition for Southeast Asia—Asian Energy '83, Singapore. Contact: Peter Teo, ITF PTE Limited, Suite 1103, 11th Floor, World Trade Center, 1 Maritime Square, Singapore 0409.

Sep 19-23: 12th World Energy Conference, New Delhi, India. Sponsor: World Energy Conference, International Executive Committee. Contact: Dr. Robert J. Raudebaugh, 1620 Eye Street, Suite 808, Washington DC 20008, phone (202) 331-0415, or E. Ruttley, World Energy Conference, 34 Saint James Street, London SW1A 1HD, England.

Nov 30-Dec 2: Sixth World Energy Engineering Congress, Atlanta, Georgia. Sponsor: Association of Energy Engineers, Atlanta, Georgia. Contact: AEE World Energy Congress, 4025 Pleasantdale Road, Suite 340, Atlanta, Georgia 30340, phone (404) 447-6424.

Dec 2-10: Caribbean/West Indies Islands Energy Cruise. Sponsor: Jordan College, Cedar Springs, Michigan. Contact: Jordan Educational Travel Services, Jordan College, 360 West Pine Street, Cedar Springs, Michigan 49319, phone (616) 696-1180.

● **Dec 12-14: Sixth Miami International Conference on Alternative Energy Sources**, Miami Beach, Florida. Contact: T. Nejat Veziroglu, Director, Clean Energy Research Institute, University of Miami, PO Box 248294, Coral Gables, Florida 33124.

CALL FOR PAPERS

A call for papers has been issued for the 6th Miami International Conference on Alternative Energy Sources, to be held December 12th through 14th, 1983. The Conference is sponsored by the Clean Energy Research Institute of the University of Miami in co-operation with the University's Mechanical Engineering Department and the International Association for Hydrogen Energy. Among the numerous subjects to be covered are OTEC, wave energy, tidal energy, and salinity-gradient power. The primary emphasis will be on the technologies associated with each energy source, but there will also be discussions on economic, social, and environmental aspects.

Prospective authors should submit titles and abstracts (about 400 words) no later than April 30th to Dr. T. Nejat Veziroglu, Director, Clean Energy Research Institute, University of Miami, PO Box 248294, Coral Gables, Florida 33124.

US GOVERNMENT PROCUREMENT INVITATIONS AND CONTRACT AWARDS

Listed below are procurement invitations and contract awards related to OTEC in particular and ocean resources in general culled from the Commerce Business Daily. This is not to be construed, however, as a complete list.

Dec 9: Design Reliability of Tension-Leg Platform (TLP) Elements: The purpose is to provide a procedure to analyze elemental and fatigue reliability of tension-leg platforms, and must consider structural strength and geometry, time-variant loads, and model uncertainties. Deliverables must include a computer program written in Fortran to evaluate TLP reliability with adequate instructions and documentation and a final report to assist in the development of an approach for selecting safety measures. The Coast Guard intends to negotiate a contract with Det Norske Veritas of Houston, Texas on a non-competitive basis, however firms which believe they can fulfill this requirement must respond in writing within ten days of publication of this notice. Responses shall refer to Solicitation 83-R-20014. A response must demonstrate that the firm has the ability to satisfactorily perform the work; has the necessary technical skills, qualified personnel, and experience; and has performed similar work in the past. This is not a request for proposals. Your response will be considered when the request for proposals is issued. No other notice will be given prior to the award. Commandant (G-FCP-2/64), US Coast Guard, Washington DC 20593.

Dec 14: Small-Business Innovation Research (SBIR) Program: Public Law 97-219—Department of Energy. Small businesses (500 employees or less, also see 13 CFR, Part 121.3-8) are invited to write for a copy of the Department of Energy's Program Solicitation covering the Small Business Innovation Research Program. No telephone requests will be honored. The purposes of Public Law 97-219 are (1) to stimulate technological innovation, (2) to use small businesses to meet federal research and development needs, (3) to foster and encourage participation by minority and disadvantaged persons in technological motivation, and (4) to increase private-sector commercialization innovations derived from Federal research and development. The SBIR program will solicit proposals on the following topics of interest to the Department: (1) Materials Sciences, (2) Chemical Separations and Analytical Instrumentation, (3) Biotechnology and Applied Microbiology, (4) Health and Environmental Effects Instrumentation, (5) Nuclear Medicine, (6) Advanced Power Generation, (7) Electric Power Transmission Technology, (8) Photovoltaic Research, (9) Transparent Solar Materials, (10) Sunlight Management in Buildings, (11) Improved Energy and Materials Use in Industry, (12) Geotechnology, (13) Fossil Fuels Research, (14) Fossil Energy Engineering and Materials, (15) Fossil Energy Instrumentation, (16) Uranium Enrichment, (17) Nuclear-Reactor Materials, (18) Nuclear-Reactor Instrumentation, (19) Commercial Nuclear Waste Management, (20) Nuclear Physics Instrumentation and Technology, (21) Particle Accelerator Technology, (22) High-Energy Physics Technology and Research, (23) Plasma Diagnostics and Instrumentation, (24) Plasma Heating Technology, and (25) Advanced Fusion Research. Successful proposers (approximately 100) may receive up to $50,000 to develop the feasibility of the idea, with up to $500,000 available in a second phase for those ideas with the most potential to meet the SBIR program objectives. Solicitations available. SBIR Program Manager, US Department of Energy, Washington DC 20545.

Dec 15: Acoustic Research and Application of Remotely Sensored Data for Fishing and Oceanographic Investigations: Negotiations are being conducted with the Charles Stark Draper Laboratory, Cambridge, Massachusetts 02139, for continuation of study. US DOC NOAA NMFS, 14 Elm Street, Gloucester, Massachusetts 01930-3799.

Dec 20: General Circulation Variability, Medium- to Long-Range Forecasting, and Energy-Industry Related Applications: Contract DE-AC-01-76-EV-01340.A011, for $397,200, awarded to Colorado State University, Fort Collins, Colorado 80523. US Departmrnt of Energy, Chicago Operations Office, Acquisition and Assistance, 9800 South Cas Avenue, Argonne, Illinois 60439.

Dec 23: Continued Research for Design and Development of the Marine Seismic System (MSS) Borehole Instrument Package: Negotiations are being conducted with Teledyne Geotech, 3401 Shiloh Road, Garland, Texas 75040. Contract negotiator Mark Thomas, (202) 696-4510. Office of Naval Research, 800 North Quincy Street, Arlington, Virginia 22217.

Dec 23: Continued Engineering Development of the Air-Deployed Oceanographic Mooring (ADOM): Negotiations are being conducted with EG&G Washington Analytical Services Center Incorporated, 2150 Fields Road, Rockville, Maryland 20850. Contract Negotiator K. Farrington, (202) 696-4510. Office of Naval Research, 800 North Quincy Street, Arlington, Virginia 22217.

Dec 23: Research for a Developmental Program in Ocean Acoustic Propagation Supporting Existing and Future Anti-Submarine Warfare (ASW) Systems: Negotiations are being conducted with the Summit Research Corporation, 1 West Deer Park Road, Gaithersburg, Maryland 20760. Contract negotiator Mark Thomas, (202) 696-4510. Office of Naval Research, 800 North Quincy Street, Arlington, Virginia 22217.

Dec 27: Training of Peace Corps Trainees in Renewable Energy Technologies: RFP to be issued within the next 45 days. Qualified training sources possessing expertise in the application of renewable energy technologies to international development are being sought. Info contained herein is for planning purposes only and does not constitute an RFP. Sources possessing such expertise may submit responses to: Peace Corps, Contracts Division, Room P-314, 806 Connecticut Avenue Northwest, Washington DC 20526.

Dec 27: Investigate the Development of Convective Storms Over the Coastal Waters of South Florida: Contract N00014-75-C-0321, November 24th, 1982 (no RFP), for $299,841, awarded to the University of Miami, Coral Gables, Florida 33124. Office of Naval Research, 800 North Quincy Street, Arlington, Virginia 22217.

Dec 27: Continued Research on Transition and Turbulence Control of Boundary Layers in Water: Contract N00014-81-K-0551, November 29th, 1982 (no RFP), for $367, 454, awarded to the California Institute of Technology, Pasadena, California 91125. Office of Naval Research, 800 North Quincy Street, Arlington, Virginia 22217.

COMING UP IN FEBRUARY'S ISSUE

- **The first part of a series on OTEC activities in Jamaica.**
- **A report on a French OTEC/desalination study.**
- **A summary of the US program of research into marine biomass for energy.**
- **And more.**

OEC MEMBERSHIP DRIVE

Many people are aware that these are hard times for alternative energy programs, in Washington and elsewhere. In response the Ocean Energy Council (OEC) has revised its goals and is accelerating its efforts to secure support for ocean-energy projects (see the September issue of OE). Part of this renewed activity is a drive to secure a broader and stronger base of support for the OEC through increased membership.

Readers who would like more information on the OEC should contact Bob Scott, Secretary, Ocean Energy Council, c/o Gibbs & Cox Incorporated, 1235 Jefferson Davis Highway, Crystal Gateway 1, Suite 700, Arlington, Virginia 22202, (703) 979-1240.